Intelligent Systems: Reasoning and Recognition

James L. Crowley

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Conditions: You have the right to use any notes or written material. You may answer questions in English or in French. When appropriate, illustrate your answer with mathematics. Your written answers must be clear and legible. Illegible text will not be graded. Duration: 3 hours.

1) (4 points) Write a critical evaluation of the technology for expert systems. What can be done with these techniques? What are the limitations?

2) (2 points) Explain the difference between the following two CLIPS rules. Is one of the rules more efficient than the other? Explain your response.

```
(defrule A
        (person (nom ?n1) )
        (person (nom ?n2&:(neq ?n1 ?n2)))
=>
)

(defrule B
        (person (nom ?n1))
        (person (nom ?n2))
        (test (neq ?n1 ?n2))
=>
)
```

3) (2 points) Given the following deftemplates in CLIPS:

```
(deftemplate product-price (slot ID)(slot price))
(deftemplate product-name (slot ID) (slot name))
```

Write a rule in CLIPS that will select and print the name and price of the least expensive product.

4) (2 points) You are asked to program a planning system for Block World using the GRAPHSEARCH algorithm. What cost function would you use for planning? Is there an heuristic for your cost function that will provide an optimal search? If yes, what is the heuristic? If no, can you still use the GRAPHSEARCH algorithm? What kind of search does the algorithm perform?

5) (10 points) You have been hired as a political analyst. You are working on the political campagne for a referendum. Your job is to identify the sectors of the population for which you can design targeted publicity. For this you prepare a questionnaire for a poll. Each question has a small number of possible response. The questions are as follows:

1) What is your age? A) 18-29, B) 30-39, C) 40-49, D) 50-59, E) 60 or older
2) What is your sex? A) Male, B) Female.
3) What is level of education? A) High-school B) University Bachelor, C) Masters Degree D) Doctorate, E) Other.
4) What is your annual Salary? A) < 15 000 B) 15 001 to 30 000 C) 30 001 to 60 000 D) 60 001 to 90 000, E) More than 90 000.
5) How will you vote in the referendum? A) Yes, B) No, C) Undecided, D) I do not plan to vote.

a) (2 points) For the group who have responded A or B in Question 5, eplain how to use a ratio of histograms to predict the most likely vote for each category of age. How many persons should be polled? How can you determine the probability of error for your prediction?

b) (2 points) Explain how to use a ratio of histograms to predict the response to question 5 as a function of the answers to questions 1, 2, 3, and 4. How many people must you poll? How can you predict the probability of error?

c) (2 points) Explain how to use a quadratic discrimination formula to predict the response to question 5 given the responses to questions 1, 2, 3, and 4.

d) (2 points) Explain how to use the EM algorithm to discover categories of voters who are likely to vote non given their responses to questions 1, 2, 3, and 4.

e) (2 points) Explain how to use boosting to learn a committee of linear classifiers to recognize if a voter will vote yes or no based on his response to questions 1, 2, 3, and 4.